FCC CO-LOCATION RADIO TEST REPORT

FCC ID	:	UZ7MC9401
Equipment	:	Mobile Computer
Brand Name	:	ZEBRA
Model Name	:	MC9401
Applicant	:	Zebra Technologies Corporation 1 Zebra Plaza, Holtsville, NY 11742
Manufacturer	:	Zebra Technologies Corporation 1 Zebra Plaza, Holtsville, NY 11742
Standard	:	FCC Part 15 Subpart E §15.407

The product was received on Jul. 10, 2023 and testing was performed from Jul. 29, 2023 to Aug. 12, 2023. We, Sporton International Inc. Wensan Laboratory, would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval from Sporton International Inc. Wensan Laboratory, the test report shall not be reproduced except in full.

Louis Wu

Approved by: Louis Wu

Sporton International Inc. Wensan Laboratory
No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.)

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History of this test report

Report No.	Version	Description	Issue Date
FR362117G	01	Initial issue of report	Aug. 24, 2023

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.1	15.407(b)	Unwanted Emissions	Pass	1.44 dB under the limit at 2483.53 MHz
3.2	15.203 15.407(a)	Antenna Requirement	Pass	-

Conformity Assessment Condition:
1. The test results (PASS/FAIL) with all measurement uncertainty excluded are presented against the regulation limits or in accordance with the requirements stipulated by the applicant/manufacturer who shall bear all the risks of non-compliance that may potentially occur if measurement uncertainty is taken into account. 2. The measurement uncertainty please refer to each test result in the section “Measurement Uncertainty”.
Disclaimer:
The product specifications of the EUT presented in the test report that may affect the test assessments are declared by the manufacturer who shall take full responsibility for the authenticity.

Reviewed by: Keven Cheng

Report Producer: Ming Chen

1 General Description

1.1 Product Feature of Equipment Under Test

Product Feature	
Equipment	Mobile Computer
Brand Name	ZEBRA
Model Name	MC9401
FCC ID	UZ7MC9401
EUT supports Radios application	NFC WLAN 11a/b/g/n HT20/HT40 WLAN 11ac VHT20/VHT40/VHT80/VHT160 WLAN 11ax HE20/HE40/HE80/HE160 Bluetooth BR/EDR/LE
HW Version	EV
SW Version	13-05-28.00-TG-U00-PRD-NEM-04
FW Version	FUSION_QA_6_1.0.0.001_T
MFD	08JUN23
EUT Stage	Identical Prototype

Remark: The EUT's information above is declared by manufacturer.

Specification of Accessories				
Adapter USB Wall Charger	**Brand Name**	Zebra	**Model Number**	PWR-WUA5V12W0US
Battery Standard Battery (7000mAh)	**Brand Name**	Zebra	**Model Number**	BT-000370
Earphone USB-C Audio Headset	**Brand Name**	Zebra	**Model Number**	HDST-USBC-PTT1-01
USB Cable (Type C to Type A)	**Brand Name**	Zebra	**Model Number**	CBL-TC2X-USBC-01
Holster	**Brand Name**	Zebra	**Model Number**	SG-MC9X-SHLSTG-01
USB Cable (CUP)	**Brand Name**	Zebra	**Model Number**	CBL-MC93-USBCHG-01

1.2 Product Specification of Equipment Under Test

Product Specification is subject to this standard	
Tx/Rx Channel Frequency Range	2402 MHz ~ 2480 MHz 2412 MHz ~ 2472 MHz 5180 MHz ~ 5240 MHz
Antenna Type / Gain	**<Bluetooth – LE>** **<Ant. 7>:** Coupling Antenna Antenna with gain 2.59 dBi **<2412 MHz ~ 2462 MHz>** **<Ant. 6>:** Coupling Antenna Antenna with gain 2.76 dBi **<Ant. 7>:** Coupling Antenna Antenna with gain 2.59 dBi **<5180 MHz ~ 5240MHz>** **<Ant. 6>:** Coupling Antenna Antenna with gain 3.01 dBi **<Ant. 7>:** Coupling Antenna Antenna with gain 3.07 dBi
Type of Modulation	Bluetooth LE: GFSK 802.11ax: OFDMA (BPSK / QPSK / 16QAM / 64QAM / 256QAM / 1024QAM)
Antenna Function for Transmitter	

	Ant. 6	Ant. 7
Bluetooth-LE	-	V
802.11ax	V	-
802.11ax MIMO	V	V

Remark:

1. MIMO Ant. 6+7 is a calculated result from sum of the power MIMO Ant. 6 and MIMO Ant. 7.
2. The EUT's information above is declared by manufacturer. Please refer to Disclaimer in report summary.

1.3 Modification of EUT

No modifications are made to the EUT during all test items.

1.4 Testing Location

Test Site	Sporton International Inc. Wensan Laboratory
Test Site Location	No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.) TEL: +886-3-327-0868 FAX: +886-3-327-0855
Test Site No.	**Sporton Site No.**
	03CH15-HY

Note: The test site complies with ANSI C63.4 2014 requirement.

FCC designation No.: TW3786

1.5 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart E
- FCC Part 15 Subpart C §15.247
- FCC KDB Publication No. 558074 D01 15.247 Meas Guidance v05r02
- FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.
- FCC KDB 414788 D01 Radiated Test Site v01r01.
- FCC KDB 662911 D01 Multiple Transmitter Output v02r01.
- ANSI C63.10-2013

Remark:

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. The TAF code is not including all the FCC KDB listed without accreditation.
3. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.

2 Test Configuration of Equipment Under Test

The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, the measured emission level of the EUT was maximized by rotating the EUT on a turntable, adjusting the orientation of the EUT and EUT antenna in three orthogonal axis (X: flat, Y: portrait, Z: landscape), and adjusting the measurement antenna orientation, following C63.10 exploratory test procedures and only the worst case emissions were reported in this report.

2.1 Carrier Frequency and Channel

2400-2483.5 MHz				5150-5250 MHz	
Bluetooth-LE		802.11ax HE20		802.11ax HE40	
Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
39	2480	11	2462	38	5190

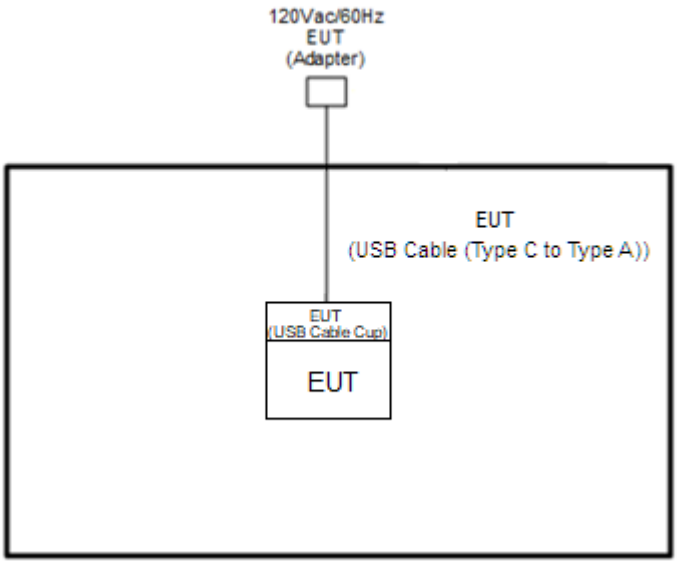
2.2 Test Mode

Final test modes are considering the modulation and worse data rates as below table.

<Co-Location>

Test Mode	Modulation	Data Rate
Mode 1	**WLAN 2.4GHz 802.11ax HE20 for MIMO <Ant. 6+7> + WLAN 5GHz 802.11ax HE40 for MIMO <Ant. 6+7>**	**MCS0 + MCS0**
Mode 2	**Bluetooth-LE for <Ant. 7> + WLAN 2.4GHz 802.11ax HE20 for <Ant. 6> + WLAN 5GHz 802.11ax HE40 for MIMO <Ant. 6+7>**	**2Mbps + MCS0 + MCS0**

2.3 Connection Diagram of Test System



2.4 Support Unit used in test configuration and system

Item	Equipment	Brand Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Notebook	Dell	Latitude 3400	FCC DoC	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m

2.5 EUT Operation Test Setup

The RF test items, utility “QRCT Version 4.0.00211.0” was installed in Notebook which was programmed in order to make the EUT get into the engineering modes to provide channel selection, power level, data rate and the application type and for continuous transmitting signals.

3 Test Result

3.1 Unwanted Emissions Measurement

This section is to measure unwanted emissions through radiated measurement for band edge spurious emissions and out of band emissions measurement.

3.1.1 Limit of Unwanted Emissions

(1) Unwanted spurious emissions fallen in restricted bands shall comply with the general field strength limits as below table:

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3

Note: The following formula is used to convert the EIRP to field strength.

$$E=\frac{1000000\sqrt{30P}}{3}$$ μV/m, where P is the eirp (Watts)

EIRP (dBm)	Field Strength at 3m (dBμV/m)
- 27	68.3

(2) KDB789033 D02 v02r01 G)2)c)

(i) Sections 15.407(b)(1-3) specifies the unwanted emissions limit for the U-NII-1 and U-NII-2 bands. As specified, emissions above 1000 MHz that are outside of the restricted bands are subject to a peak emission limit of −27 dBm/MHz.

(ii) Section 15.407(b)(4) specifies the unwanted emissions limit for the U-NII-3 band. A band emissions mask is specified in Section 15.407(b)(4)(i). The emission limits are based on the use of a peak detector.

3.1.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.1.3 Test Procedures

1. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01. Section G) Unwanted emissions measurement.

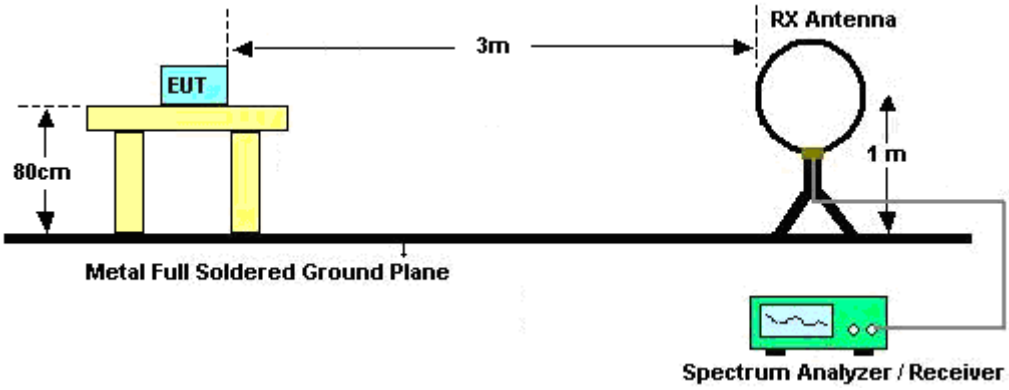
   (1) Procedure for Unwanted Emissions Measurements Below 1000MHz
   - RBW = 120 kHz
   - VBW = 300 kHz
   - Detector = Peak
   - Trace mode = max hold

   (2) Procedure for Peak Unwanted Emissions Measurements Above 1000 MHz
   - RBW = 1 MHz
   - VBW ≥ 3 MHz
   - Detector = Peak
   - Sweep time = auto
   - Trace mode = max hold

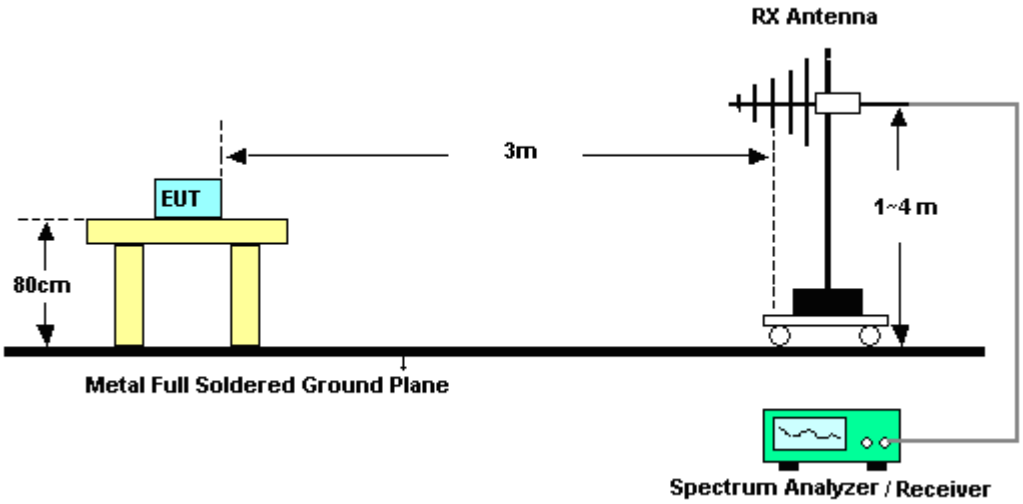
   (3) Procedures for Average Unwanted Emissions Measurements Above 1000MHz
   - RBW = 1 MHz
   - VBW = 10 Hz, when duty cycle is no less than 98 percent.
   - VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.
2. The EUT is placed on a turntable with 0.8 meter for frequency below 1 GHz and 1.5 meter for frequency above 1 GHz respectively above ground.
3. The EUT is set 3 meters away from the receiving antenna which is mounted on the top of a variable height antenna tower.
4. The antenna is a broadband antenna and its height is adjusted between one meter and four meters above ground to find the maximum value of the field strength for both horizontal polarization and vertical polarization of the antenna.
5. For each suspected emission, the EUT is arranged to its worst case and then adjust the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading.
6. Radiated testing below 1 GHz is performed by adjusting the antenna tower from 1 m to 4 m and by rotating the turn table from 0 degree to 360 degrees to find the peak maximum hold reading. When there is no suspected emission found and the emission level is with at least 6 dB margin against QP limit line, the position is marked as “-“.
7. Radiated testing above 1 GHz is performed by adjusting the antenna tower from 1 m to 4 m and by rotating the turn table from 0 degree to 360 degrees to find the peak maximum hold reading for scanning all frequencies. When there is no suspected emission found and the harmonic emission level is with at least 6 dB margin against average limit line, the position is marked as “-“.

3.1.4 Test Setup

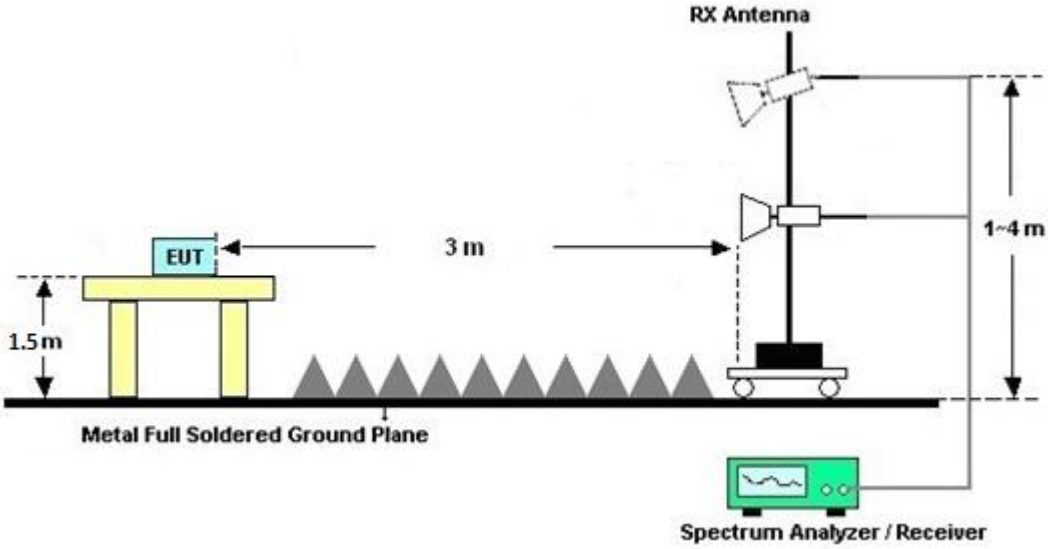
For radiated emissions below 30MHz



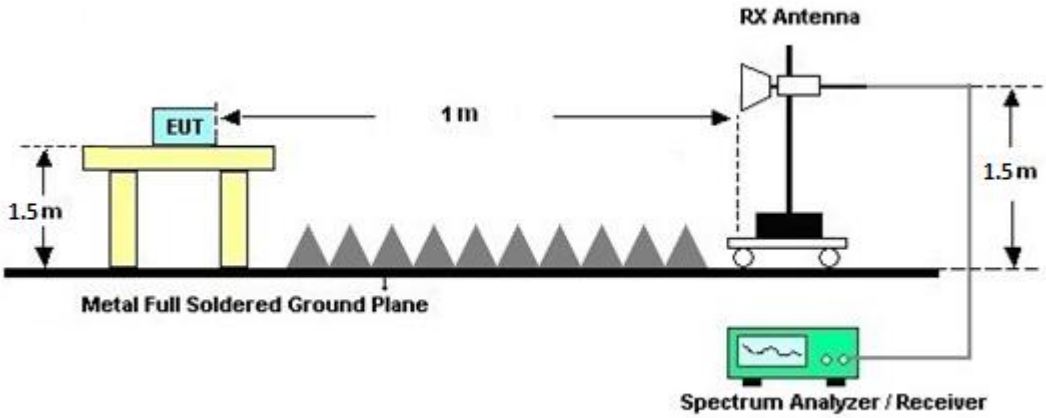
For radiated emissions from 30MHz to 1GHz



For radiated test from 1GHz to 18GHz



For radiated test above 18GHz



3.1.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported.

There is adequate comparison measurement of both open-field test site and alternative test site - semi-Anechoic chamber according to 414788 D01 Radiated Test Site v01r01, and the result came out very similar.

3.1.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix A and B.

3.1.7 Duty Cycle

Please refer to Appendix C.

3.1.8 Test Result of Radiated Spurious Emissions (30MHz ~ 10th Harmonic)

Please refer to Appendix A and B.

3.2 Antenna Requirements

3.2.1 Standard Applicable

The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the rule.

3.2.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

4 List of Measuring Equipment

Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100488	9 kHz~30 MHz	Sep. 20, 2022	Jul. 29, 2023~ Aug. 12, 2023	Sep. 19, 2023	Radiation (03CH15-HY)
Bilog Antenna	TESEQ	CBL 6111D & 00800N1D01N-06	41912 & 05	30MHz~1GHz	Feb. 05, 2023	Jul. 29, 2023~ Aug. 12, 2023	Feb. 04, 2024	Radiation (03CH15-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-1212	1GHz~18GHz	Mar. 23, 2023	Jul. 29, 2023~ Aug. 12, 2023	Mar. 22, 2024	Radiation (03CH15-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	00993	18GHz~40GHz	Nov. 24, 2022	Jul. 29, 2023~ Aug. 12, 2023	Nov. 23, 2023	Radiation (03CH15-HY)
Amplifier	SONOMA	310N	363440	9kHz~1GHz	Dec. 26, 2022	Jul. 29, 2023~ Aug. 12, 2023	Dec. 25, 2023	Radiation (03CH15-HY)
Preamplifier	EMEC	EM01G18G	060837	1GHz~18GHz	Feb. 16, 2023	Jul. 29, 2023~ Aug. 12, 2023	Feb. 15, 2024	Radiation (03CH15-HY)
Preamplifier	EM Electronics	EM01G18G	060802	1GHz~18GHz	Mar. 03, 2023	Jul. 29, 2023~ Aug. 12, 2023	Mar. 02, 2024	Radiation (03CH15-HY)
Preamplifier	EMEC	EM18G40G	060801	18GHz~40GHz	Jun. 27, 2023	Jul. 29, 2023~ Aug. 12, 2023	Jun. 26, 2024	Radiation (03CH15-HY)
EMI Test Receiver	Keysight	N9038A(MXE)	MY54130085	20MHz~8.4GHz	Oct. 18, 2022	Jul. 29, 2023~ Aug. 12, 2023	Oct. 17, 2023	Radiation (03CH15-HY
Spectrum Analyzer	Keysight	N9010A	MY54200485	10Hz~44GHz	Mar. 20, 2023	Jul. 29, 2023~ Aug. 12, 2023	Mar. 19, 2024	Radiation (03CH15-HY)
Antenna Mast	ChainTek	MBS-520-1	N/A	1m~4m	N/A	Jul. 29, 2023~ Aug. 12, 2023	N/A	Radiation (03CH15-HY)
Turn Table	ChainTek	T-200-S-1	N/A	0~360 Degree	N/A	Jul. 29, 2023~ Aug. 12, 2023	N/A	Radiation (03CH15-HY)
Software	Audix	E3 6.2009-8-24(k5)	RK-000451	N/A	N/A	Jul. 29, 2023~ Aug. 12, 2023	N/A	Radiation (03CH15-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104, 102E	MY582185/4,519228/2,803950/2	N/A	Jun. 13, 2023	Jul. 29, 2023~ Aug. 12, 2023	Jun. 12, 2024	Radiation (03CH15-HY)

5 Measurement Uncertainty

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	6.3 dB

Uncertainty of Radiated Emission Measurement (1000 MHz ~ 6000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	4.2 dB

Uncertainty of Radiated Emission Measurement (6000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	5.4 dB

Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	5.2 dB

Appendix A. Radiated Spurious Emission

Test Engineer :	Bigshow Wang	Temperature :	21.4~22.9°C
		Relative Humidity :	50~59%

2.4GHz 2400~2483.5MHz + Band 1 - 5150~5250MHz

WIFI 802.11ax HE20 (Band edge @ 3m)

WIFI Ant	Note	Frequency	Level	Margin	Limit Line	Read Level	Antenna Factor	Path Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
6+7		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
		2462	108.98	-	-	102.21	27.62	15.92	36.77	167	63	P	H
		2462	100.63	-	-	93.86	27.62	15.92	36.77	167	63	A	H
	*	2483.818	57.38	-16.62	74	50.4	27.8	15.95	36.77	167	63	P	H
	*	2483.528	47.55	-6.45	54	40.57	27.8	15.95	36.77	167	63	A	H
													H
													H
													H
													H
													H
802.11ax													H
HE20													H
CH11													H
2462MHz		2462	115.27	-	-	108.5	27.62	15.92	36.77	100	5	P	V
		2462	105.7	-	-	98.93	27.62	15.92	36.77	100	5	A	V
	*	2483.644	63.59	-10.41	74	56.61	27.8	15.95	36.77	100	5	P	V
	*	2483.528	52.56	-1.44	54	45.58	27.8	15.95	36.77	100	5	A	V
													V
													V
													V
													V
													V
													V

2.4GHz 2400~2483.5MHz + Band 1 - 5150~5250MHz

WIFI 802.11ax HE40 (Band edge @ 3m)

WIFI Ant. 6+7	Note	Frequency (MHz)	Level (dBμV/m)	Margin (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
		5146.52	55.68	-18.32	74	50.36	33.1	8.84	36.62	303	15	P	H
		5147.4	47.83	-6.17	54	42.51	33.1	8.84	36.62	303	15	A	H
	*	5190	104.26	-	-	98.81	33.18	8.89	36.62	303	15	P	H
	*	5190	97.96	-	-	92.51	33.18	8.89	36.62	303	15	A	H
		5381.1	45.53	-28.47	74	40.26	33	8.86	36.59	303	15	P	H
		5354.7	37	-17	54	31.73	33	8.87	36.6	303	15	A	H
													H
													H
													H
													H
802.11ax													H
HE40													H
CH38		5141.46	58.49	-15.51	74	53.18	33.1	8.83	36.62	203	300	P	V
5190MHz		5149.82	52.43	-1.57	54	47.11	33.1	8.84	36.62	203	300	A	V
	*	5190	108.54	-	-	103.09	33.18	8.89	36.62	203	300	P	V
	*	5190	103.26	-	-	97.81	33.18	8.89	36.62	203	300	A	V
		5358.3	45.3	-28.7	74	40.03	33	8.87	36.6	203	300	P	V
		5354.1	38.01	-15.99	54	32.74	33	8.87	36.6	203	300	A	V
													V
													V
													V
													V
													V
													V

2.4GHz 2400~2483.5MHz + Band 1 - 5150~5250MHz

802.11ax HE20_Tx_CH11 + 802.11ax HE40_Tx_CH38 (Harmonic @ 3m)

WIFI Ant. Simultaneously	Note	Frequency (MHz)	Level (dBμV/m)	Margin (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11ax HE20 CH11 + 802.11ax HE40 CH38		4924	46.99	-27.01	74	42.19	32.85	8.6	36.65	257	236	P	H
		7418	42.69	-31.31	74	53.86	36.63	10.93	58.73	257	236	P	H
		10380	48.18	-20.02	68.2	54.75	38.8	12.48	57.85	221	118	P	H
		15690	48.48	-25.52	74	51.48	38.44	15.94	57.38	-	-	P	H
		15690	38.88	-15.12	54	41.88	38.44	15.94	57.38	-	-	A	H
													H
													H
													H
													H
													H
													H
		4924	46.41	-27.59	74	41.61	32.85	8.6	36.65	256	58	P	V
		7416	42.5	-31.5	74	53.66	36.64	10.93	58.73	256	58	P	V
		10377	48.44	-19.76	68.2	55.01	38.8	12.48	57.85	100	318	P	V
		15690	48.51	-25.49	74	51.51	38.44	15.94	57.38	-	-	P	V
		15690	39.44	-14.56	54	42.44	38.44	15.94	57.38	-	-	A	V
													V
													V
													V
													V
													V
													V

Emission below 1GHz

802.11ax HE20_Tx_CH11 + 802.11ax HE40_Tx_CH38 (LF @ 3m)

WIFI Ant. Simultaneously	Note	Frequency (MHz)	Level (dBμV/m)	Margin (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11ax HE20 CH11 + 802.11ax HE40 CH38 LF		66.36	23.97	-16.03	40	43.26	12.05	1.08	32.42	-	-	P	H
		135.12	25.8	-17.7	43.5	39.16	17.58	1.47	32.41	-	-	P	H
		179.94	21.55	-21.95	43.5	37.02	15.11	1.82	32.4	-	-	P	H
		465.96	24.43	-21.57	46	30.74	23.49	2.6	32.4	-	-	P	H
		635.81	27.79	-18.21	46	30.77	26.38	3.05	32.41	-	-	P	H
		933.64	31.98	-14.02	46	29.84	29.59	3.71	31.16	-	-	P	H
													H
													H
													H
													H
													H
													H
		30.72	32.02	-7.98	40	39.45	24.24	0.72	32.39	-	-	P	V
		78.42	30.39	-9.61	40	48.44	13.2	1.17	32.42	-	-	P	V
		181.38	25.81	-17.69	43.5	41.37	15.02	1.82	32.4	-	-	P	V
		462.8	24.07	-21.93	46	30.47	23.41	2.59	32.4	-	-	P	V
		744.83	30.04	-15.96	46	31.17	27.82	3.28	32.23	-	-	P	V
		883.87	30.86	-15.14	46	30.1	28.77	3.56	31.57	-	-	P	V
													V
													V
													V
													V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against limit line. 3. The emission position marked as "-" means no suspected emission found and emission level has at least 6dB margin against limit or emission is noise floor only.												

Emission above 18GHz

802.11ax HE20_Tx_CH11 + 802.11ax HE40_Tx_CH38 (SHF @ 1m)

WIFI Ant. Simultaneously	Note	Frequency (MHz)	Level (dBμV/m)	Margin (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11ax HE20 CH11 + 802.11ax HE40 CH38 SHF		39986.5	49.03	-24.97	74	60.36	44.78	-0.29	55.82	-	-	P	H
		39986.5	39.1	-14.9	54	50.43	44.78	-0.29	55.82	-	-	A	H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
		39649	48.97	-25.03	74	61.31	44.44	-0.56	56.22	-	-	P	V
		39649	39.02	-14.98	54	51.36	44.44	-0.56	56.22	-	-	A	V
													V
													V
													V
													V
													V
													V
													V
													V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against limit line. 3. The emission position marked as "-" means no suspected emission found with sufficient margin against limit line or noise floor only.												

Bluetooth-LE + 2.4GHz 2400~2483.5MHz + Band 1 - 5150~5250MHz

Bluetooth-LE (2Mbps) (Band edge @ 3m)

BLE Ant 7	Note	Frequency (MHz)	Level (dBμV/m)	Margin (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
BLE CH39 2480MHz	*	2480	110.63	-	-	103.74	27.72	15.94	36.77	100	342	P	H
	*	2480	102.34	-	-	95.45	27.72	15.94	36.77	100	342	A	H
		2483.5	54.13	-19.87	74	47.22	27.73	15.95	36.77	100	342	P	H
		2483.62	46.14	-7.86	54	39.23	27.73	15.95	36.77	100	342	A	H
													H
													H
													H
													H
													H
													H
													H
													H
	*	2480	106.41	-	-	99.52	27.72	15.94	36.77	348	271	P	V
	*	2480	98.37	-	-	91.48	27.72	15.94	36.77	348	271	A	V
		2483.62	52.71	-21.29	74	45.8	27.73	15.95	36.77	348	271	P	V
		2483.53	45.27	-8.73	54	38.36	27.73	15.95	36.77	348	271	A	V
													V
													V
													V
													V
													V
													V
													V
													V

Bluetooth-LE + 2.4GHz 2400~2483.5MHz + Band 1 - 5150~5250MHz

WIFI 802.11ax HE20 (Band edge @ 3m)

WIFI Ant 6	Note	Frequency (MHz)	Level (dBμV/m)	Margin (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
	*	2462	109.33	-	-	102.53	27.65	15.92	36.77	100	342	P	H
	*	2462	101.02	-	-	94.22	27.65	15.92	36.77	100	342	A	H
		2483.528	53.45	-20.55	74	46.54	27.73	15.95	36.77	100	342	P	H
		2483.528	43.54	-10.46	54	36.63	27.73	15.95	36.77	100	342	A	H
													H
													H
													H
													H
													H
													H
802.11ax													H
HE20													H
CH11	*	2462	107.74	-	-	100.94	27.65	15.92	36.77	348	271	P	V
2462MHz	*	2462	97.16	-	-	90.36	27.65	15.92	36.77	348	271	A	V
		2483.818	53.47	-20.53	74	46.55	27.74	15.95	36.77	348	271	P	V
		2483.528	42.78	-11.22	54	35.87	27.73	15.95	36.77	348	271	A	V
													V
													V
													V
													V
													V
													V
													V
													V

Bluetooth-LE + 2.4GHz 2400~2483.5MHz + Band 1 - 5150~5250MHz

WIFI 802.11ax HE40 (Band edge @ 3m)

WIFI Ant. 6+7	Note	Frequency (MHz)	Level (dBμV/m)	Margin (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11ax HE40 CH38 5190MHz		5148.28	57.32	-16.68	74	52.15	32.95	8.84	36.62	244	47	P	H
		5149.82	51.22	-2.78	54	46.05	32.95	8.84	36.62	244	47	A	H
	*	5190	108.02	-	-	102.84	32.91	8.89	36.62	244	47	P	H
	*	5190	101.43	-	-	96.25	32.91	8.89	36.62	244	47	A	H
		5436.6	46.49	-27.51	74	41.38	32.8	8.9	36.59	244	47	P	H
		5459.7	38.41	-15.59	54	33.27	32.8	8.92	36.58	244	47	A	H
													H
													H
													H
													H
													H
													H
		5149.82	54.83	-19.17	74	49.66	32.95	8.84	36.62	238	101	P	V
		5150	47.5	-6.5	54	42.33	32.95	8.84	36.62	238	101	A	V
	*	5190	106.47	-	-	101.29	32.91	8.89	36.62	238	101	P	V
	*	5190	100.98	-	-	95.8	32.91	8.89	36.62	238	101	A	V
		5408.4	46.16	-27.84	74	41.08	32.8	8.87	36.59	238	101	P	V
		5357.1	38.49	-15.51	54	33.42	32.8	8.87	36.6	238	101	A	V
													V
													V
													V
													V
													V
													V

Bluetooth-LE + 2.4GHz 2400~2483.5MHz + Band 1 - 5150~5250MHz

Bluetooth-LE (2Mbps) _Tx_CH39 + 802.11ax HE20_Tx_CH11 + 802.11ax HE40_Tx_CH38

(Harmonic @ 3m)

WIFI Ant.	Note	Frequency	Level	Margin	Limit Line	Read Level	Antenna Factor	Path Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
Simultaneously		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
BLE_Tx_CH39 + 802.11ax HE20 CH11 + 802.11ax HE40 CH38		4924	48.43	-25.57	74	43.66	32.82	8.6	36.65	-	-	P	H
		4924	39.28	-14.72	54	34.51	32.82	8.6	36.65	-	-	A	H
		4960	49.18	-24.82	74	44.2	33	8.63	36.65	-	-	P	H
		4960	39.25	-14.75	54	34.27	33	8.63	36.65	-	-	A	H
		7386	42.29	-31.71	74	53.81	36.28	10.91	58.71	-	-	P	H
		7440	41.27	-32.73	74	52.95	36.12	10.95	58.75	-	-	P	H
		10380	46.8	-21.4	68.2	53.62	38.55	12.48	57.85	-	-	P	H
		15570	48.55	-25.45	74	51.81	38.23	15.84	57.33	-	-	P	H
		15570	39.56	-14.44	54	42.82	38.23	15.84	57.33	-	-	A	H
													H
													H
													H
		4924	48.93	-25.07	74	44.16	32.82	8.6	36.65	-	-	P	V
		4924	39.96	-14.04	54	35.19	32.82	8.6	36.65	-	-	A	V
		4960	48.45	-25.55	74	43.47	33	8.63	36.65	-	-	P	V
		4960	39.57	-14.43	54	34.59	33	8.63	36.65	-	-	A	V
		7386	44.5	-29.5	74	56.02	36.28	10.91	58.71	-	-	P	V
		7440	42.24	-31.76	74	53.92	36.12	10.95	58.75	-	-	P	V
		10380	47.1	-21.1	68.2	53.92	38.55	12.48	57.85	-	-	P	V
		15570	49.2	-24.8	74	52.46	38.23	15.84	57.33	-	-	P	V
		15570	40.3	-13.7	54	43.56	38.23	15.84	57.33	-	-	A	V
													V
													V
													V

Emission below 1GHz

Bluetooth-LE (2Mbps) _Tx_CH39 + 802.11ax HE20_Tx_CH11 + 802.11ax HE40_Tx_CH38 (LF @ 3m)

WIFI Ant. Simultaneously	Note	Frequency (MHz)	Level (dBμV/m)	Margin (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
BLE_Tx_CH39 + 802.11ax HE20 CH11 + 802.11ax HE40 CH38 LF		46.56	22.8	-17.2	40	38.23	16.12	0.9	32.45	-	-	P	H
		101.46	24.79	-18.71	43.5	39.68	16.2	1.32	32.41	-	-	P	H
		179.94	21.55	-21.95	43.5	37.02	15.11	1.82	32.4	-	-	P	H
		635.81	27.79	-18.21	46	30.77	26.38	3.05	32.41	-	-	P	H
		871.23	31.51	-14.49	46	30.62	29.02	3.53	31.66	-	-	P	H
		960.5	33.77	-20.23	54	29.98	30.95	3.77	30.93	-	-	P	H
													H
													H
													H
													H
													H
													H
		30.54	30.82	-9.18	40	38.2	24.29	0.72	32.39	-	-	P	V
		66.9	31.05	-8.95	40	50.31	12.08	1.08	32.42	-	-	P	V
		83.28	29.69	-10.31	40	47.04	13.85	1.21	32.41	-	-	P	V
		506.25	25.28	-20.72	46	31.04	23.92	2.71	32.39	-	-	P	V
		567.87	27.01	-18.99	46	30.43	26.11	2.91	32.44	-	-	P	V
		857.8	30.88	-15.12	46	30.04	29.11	3.49	31.76	-	-	P	V
													V
													V
													V
													V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against limit line. 3. The emission position marked as "-" means no suspected emission found and emission level has at least 6dB margin against limit or emission is noise floor only.												

Emission above 18GHz

Bluetooth-LE (2Mbps) _Tx_CH39 + 802.11ax HE20_Tx_CH11 + 802.11ax HE40_Tx_CH38 (SHF @ 1m)

WIFI Ant. Simultaneously	Note	Frequency (MHz)	Level (dBμV/m)	Margin (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
BLE_Tx_CH39 + 802.11ax HE20 CH11 + 802.11ax HE40 CH38 SHF		39959.5	48.62	-25.38	74	60.04	44.74	-0.31	55.85	-	-	P	H
		39959.5	38.65	-15.35	54	50.07	44.74	-0.31	55.85	-	-	A	H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
		39986.5	48.48	-25.52	74	59.81	44.78	-0.29	55.82	-	-	P	V
		39986.5	38.5	-15.5	54	49.83	44.78	-0.29	55.82	-	-	A	V
													V
													V
													V
													V
													V
													V
													V
													V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against limit line. 3. The emission position marked as "-" means no suspected emission found with sufficient margin against limit line or noise floor only.												

Note symbol

*	**Fundamental Frequency** which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
!	Test result is **over limit** line.
P/A	**P**eak or **A**verage
H/V	**H**orizontal or **V**ertical

A calculation example for radiated spurious emission is shown as below:

WIFI Ant.	Note	Frequency (MHz)	Level (dBμV/m)	Margin (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11b CH 01 2412MHz		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H

1. Path Loss(dB) = Cable loss(dB) + Filter loss(dB) + Attenuator loss(dB)
2. Level(dBμV/m) = Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)
3. Over Limit(dB) = Level(dBμV/m) – Limit Line(dBμV/m)

For Peak Limit @ 2390MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 54.51(dBμV) – 35.86 (dB)

= 55.45 (dBμV/m)

2. Margin(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 55.45(dBμV/m) – 74(dBμV/m)

= -18.55(dB)

For Average Limit @ 2390MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 42.6(dBμV) – 35.86 (dB)

= 43.54 (dBμV/m)

2. Margin (dB) = Level(dBμV/m) – Limit Line(dBμV/m)

= 43.54(dBμV/m) – 54(dBμV/m)

= -10.46(dB)

Both peak and average measured complies with the limit line, so test result is “PASS”.

Appendix B. Radiated Spurious Emission Plots

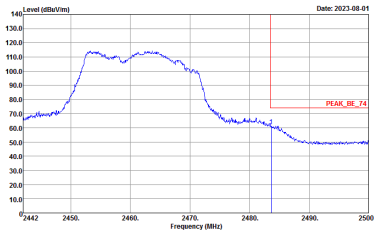
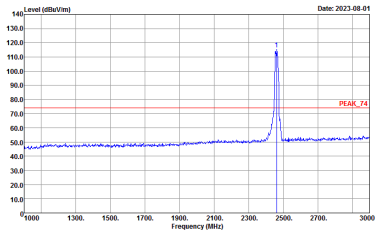
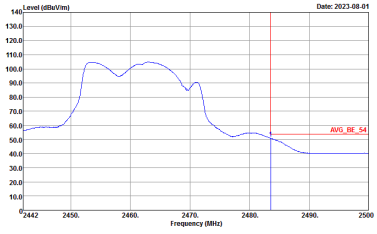
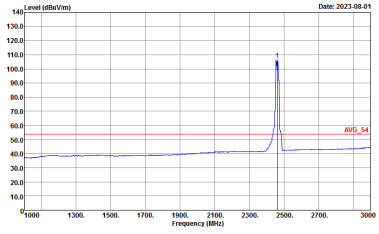
Test Engineer :	Bigshow Wang	**Temperature :**	21.4~22.9°C
		Relative Humidity :	50~59%

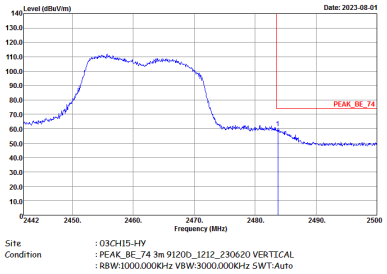
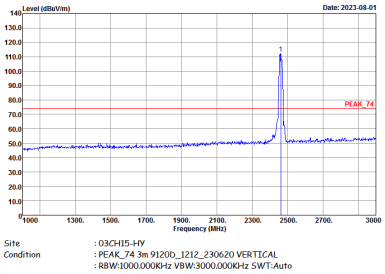
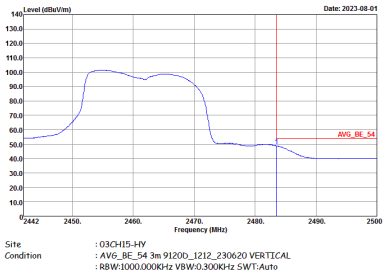
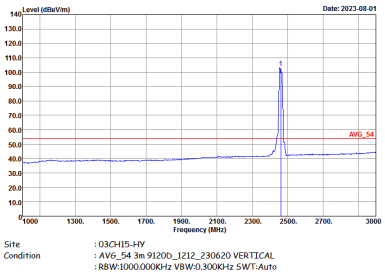
Note symbol

-L	**Low channel location**
-R	**High channel location**

2.4GHz 2400~2483.5MHz + Band 1 - 5150~5250MHz

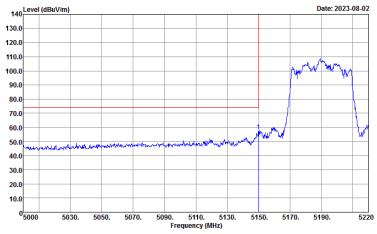
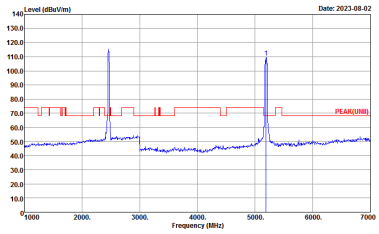
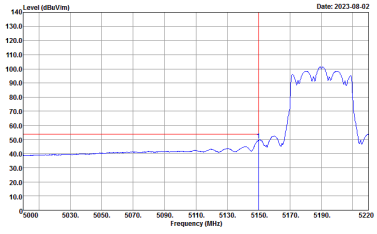
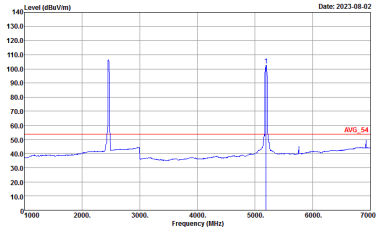
WIFI 802.11ax HE20 (Band Edge @ 3m)

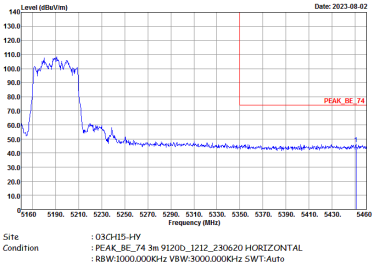
WLAN	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11ax HE20_Tx_CH11 2462MHz - L	
6+7	Horizontal	Fundamental
Peak		
Avg.		

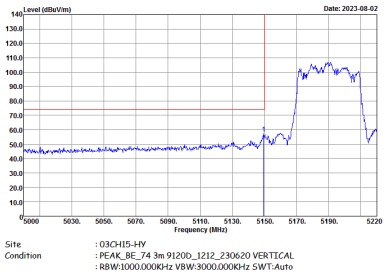
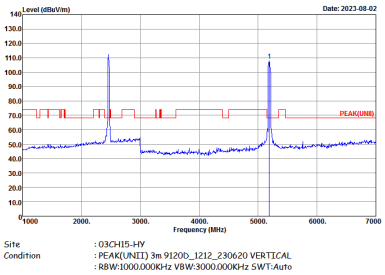
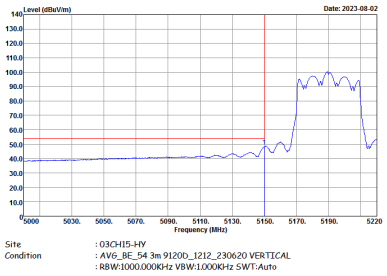
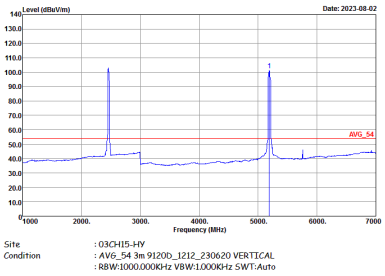
WLAN	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11ax HE20_Tx_CH11 2462MHz - L	
6+7	Vertical	Fundamental
Peak		
Avg.		

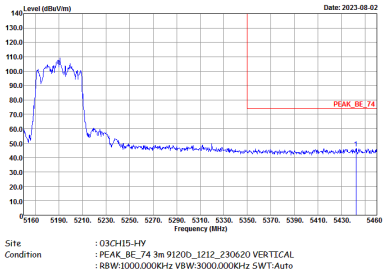
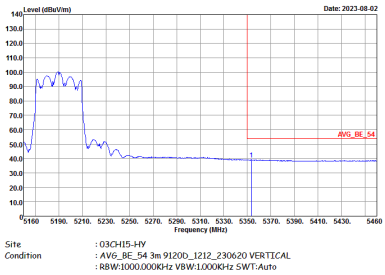
2.4GHz 2400~2483.5MHz + Band 1 - 5150~5250MHz

WIFI 802.11ax HE40 (Band Edge @ 3m)

WIFI	Band 1 5150~5250MHz Band Edge @ 3m	
ANT	802.11ax HE40_Tx_CH38 5190MHz	
6+7	Horizontal	Fundamental
Peak		
Avg.		

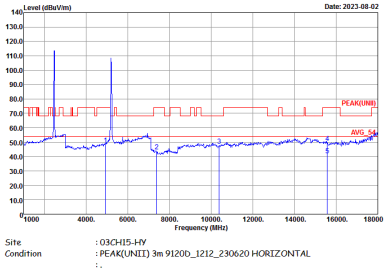
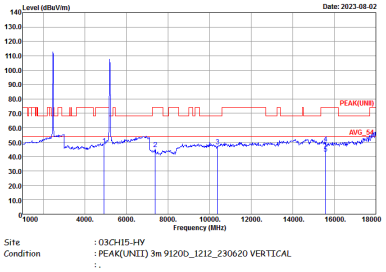
WIFI	Band 1 5150~5250MHz Band Edge @ 3m	
ANT	802.11ax HE40_Tx_CH38 5190MHz	
6+7	Horizontal	Fundamental
Peak		-
Avg.		-

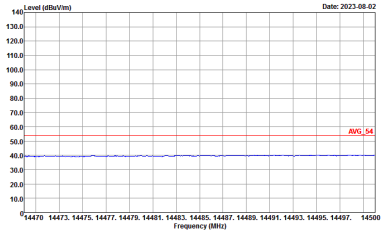
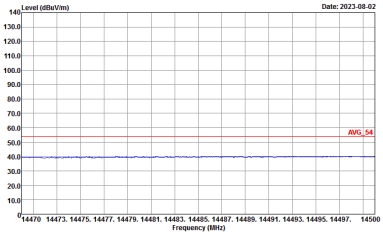
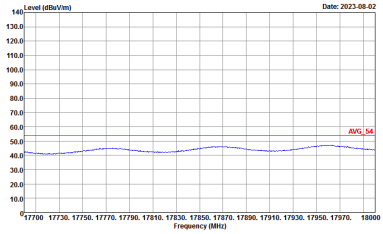
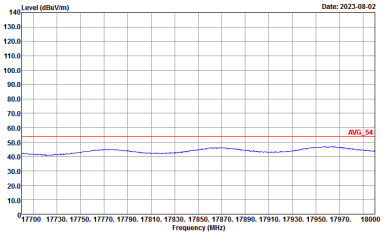
WIFI	Band 1 5150~5250MHz Band Edge @ 3m	
ANT	802.11ax HE40_Tx_CH38 5190MHz	
6+7	Vertical	Fundamental
Peak		
Avg.		

WIFI	Band 1 5150~5250MHz Band Edge @ 3m	
ANT	802.11ax HE40_Tx_CH38 5190MHz	
6+7	Vertical	Fundamental
Peak		-
Avg.		-

2.4GHz 2400~2483.5MHz + Band 1 - 5150~5250MHz

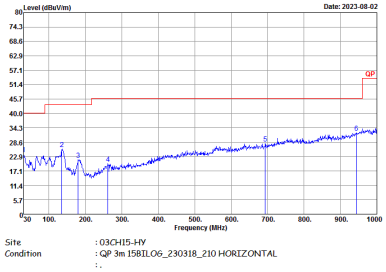
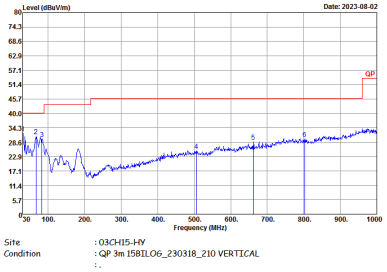
802.11ax HE20_Tx_CH11 + 802.11ax HE40_Tx_CH38 (Harmonic @ 3m)

WIFI	2.4GHz 2400~2483.5MHz + Band 1 5150~5250MHz Harmonic @ 3m	
Ant.	802.11ax HE20_Tx_CH11 + 802.11ax HE40_Tx_CH38	
Simultaneously	Horizontal	Vertical
Peak Avg.		

WIFI	2.4GHz 2400~2483.5MHz + Band 1 5150~5250MHz Harmonic @ 3m	
Ant.	802.11ax HE20_Tx_CH11 + 802.11ax HE40_Tx_CH38	
Simultaneously	Horizontal	Vertical
Avg.	 Site : 03CH15-HY Condition : AV6_54 3m 9120D_1212_230620 HORIZONTAL : .	 Site : 03CH15-HY Condition : AV6_54 3m 9120D_1212_230620 VERTICAL : .
AVG	 Site : 03CH15-HY Condition : AV6_54 3m 9120D_1212_230620 HORIZONTAL : .	 Site : 03CH15-HY Condition : AV6_54 3m 9120D_1212_230620 VERTICAL : .

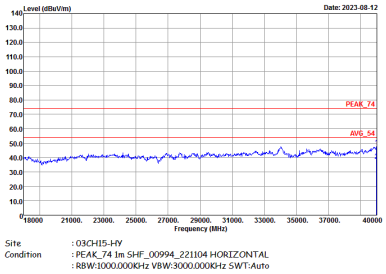
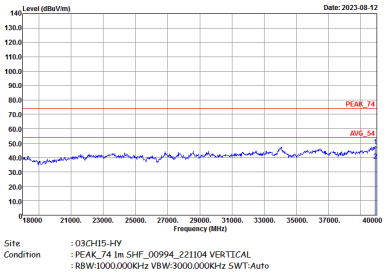
Emission below 1GHz

802.11ax HE20_Tx_CH11 + 802.11ax HE40_Tx_CH38 (LF)

WIFI	2.4GHz 2400~2483.5MHz + Band 1 5150~5250MHz LF @ 3m	
Ant.	802.11ax HE20_Tx_CH11 + 802.11ax HE40_Tx_CH38	
Simultaneously	Horizontal	Vertical
QP / Peak		

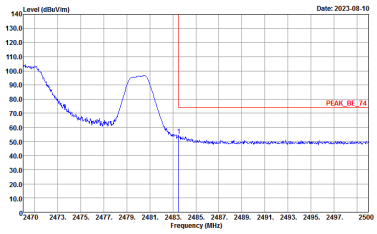
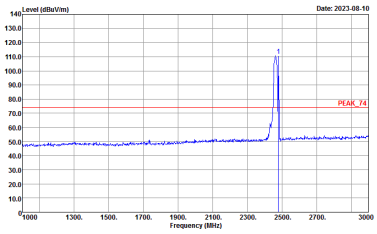
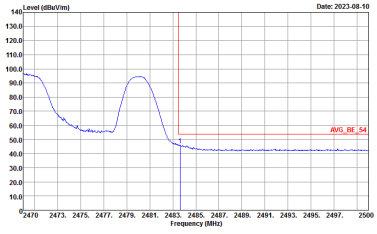
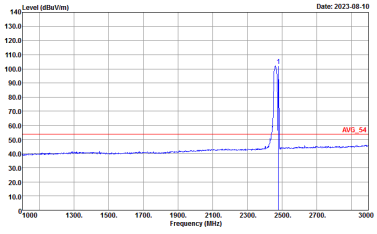
Emission above 18GHz

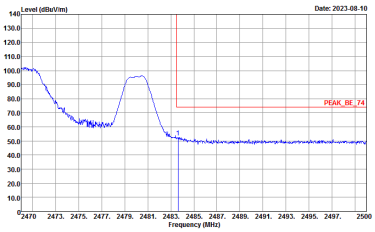
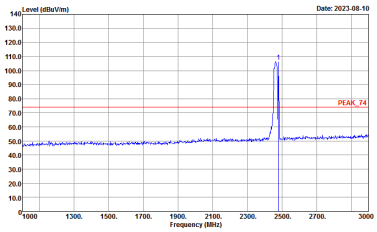
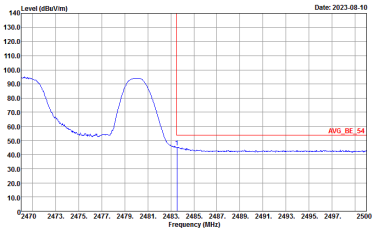
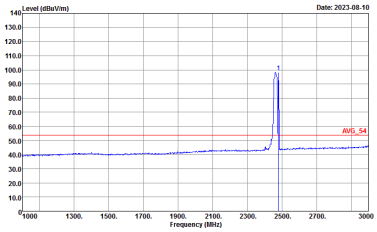
802.11ax HE20_Tx_CH11 + 802.11ax HE40_Tx_CH38 (SHF)

WIFI	2.4GHz 2400~2483.5MHz + Band 1 5150~5250MHz	
Ant.	802.11ax HE20_Tx_CH11 + 802.11ax HE40_Tx_CH38	
Simultaneously	Horizontal	Vertical
Peak Avg.		

Bluetooth-LE + 2.4GHz 2400~2483.5MHz + Band 1 - 5150~5250MHz

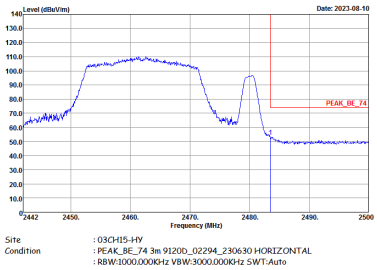
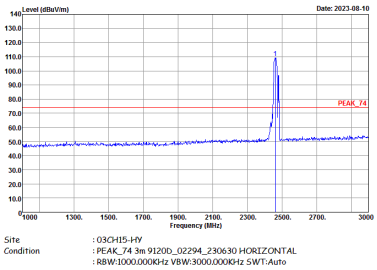
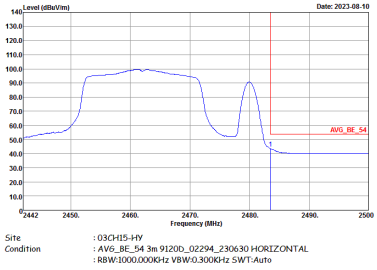
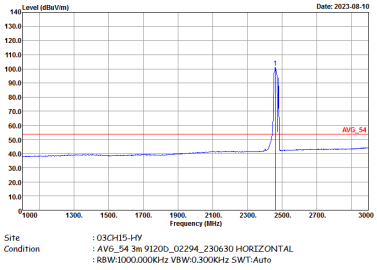
Bluetooth-LE (Band Edge @ 3m)

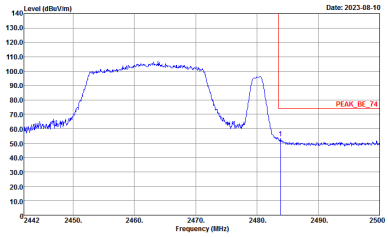
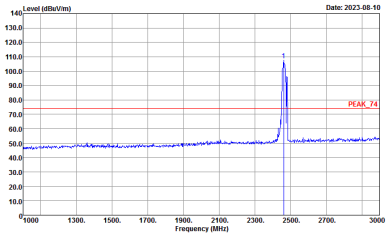
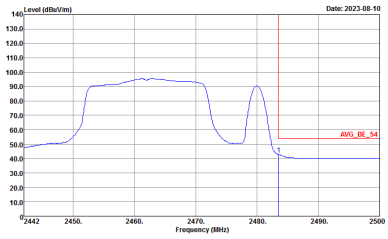
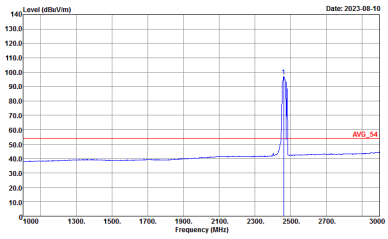
BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	Bluetooth-LE_Tx_CH39	
7	Horizontal	Fundamental
Peak		
Avg.		

BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	Bluetooth-LE_Tx_CH39	
7	Vertical	Fundamental
Peak	 Site : 03CH15-HY Condition : PEAK_BE_74 3m 9120D_02294_230630 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto	 Site : 03CH15-HY Condition : PEAK_74 3m 9120D_02294_230630 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto
Avg.	 Site : 03CH15-HY Condition : AVG_BE_54 3m 9120D_02294_230630 VERTICAL : RBW:1000.000KHz VBW:10.000KHz SWT:Auto	 Site : 03CH15-HY Condition : AVG_54 3m 9120D_02294_230630 VERTICAL : RBW:1000.000KHz VBW:10.000KHz SWT:Auto

Bluetooth-LE + 2.4GHz 2400~2483.5MHz + Band 1 - 5150~5250MHz

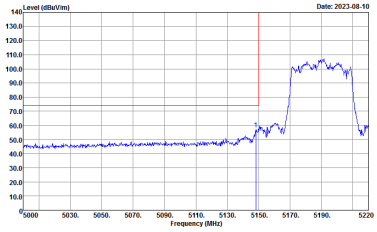
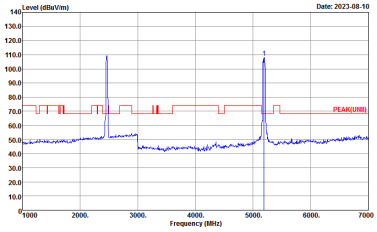
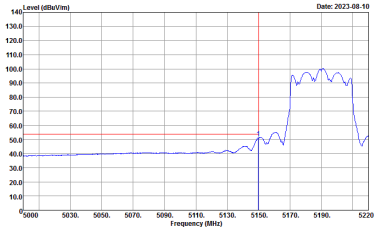
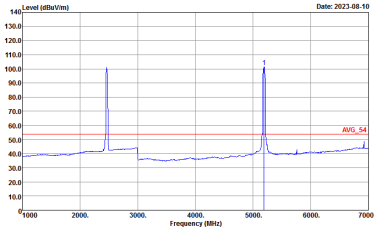
WIFI 802.11ax HE20 (Band Edge @ 3m)

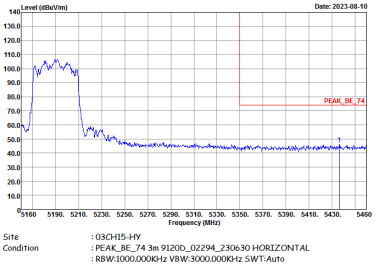
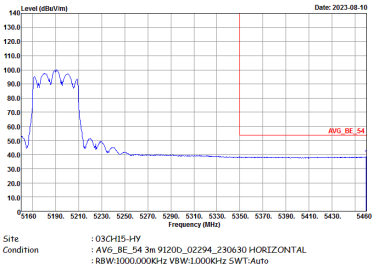
WLAN	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	11axHE20_Tx_Ch11 2462MHz - L	
6	Horizontal	Fundamental
Peak		
Avg.		

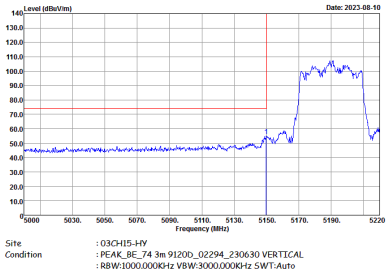
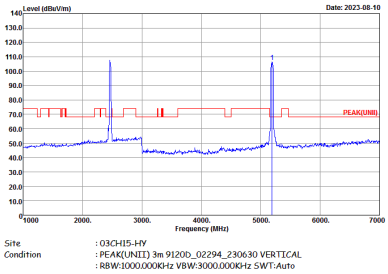
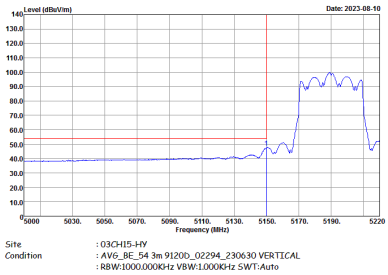
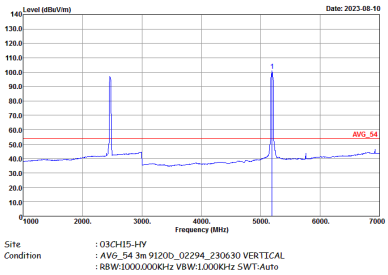
WLAN	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11ax HE20_Tx_CH11 2462MHz - L	
6	Vertical	Fundamental
Peak		
Avg.		

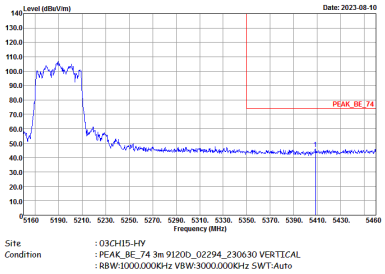
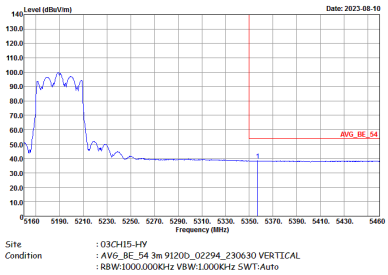
Bluetooth-LE + 2.4GHz 2400~2483.5MHz + Band 1 - 5150~5250MHz

WIFI 802.11ax HE40 (Band Edge @ 3m)

WIFI	Band 1 5150~5250MHz Band Edge @ 3m	
ANT	802.11ax HE40_Tx_CH38 5190MHz	
6+7	Horizontal	Fundamental
Peak		
Avg.		

WIFI	Band 1 5150~5250MHz Band Edge @ 3m	
ANT	802.11ax HE40_Tx_CH38 5190MHz	
6+7	Horizontal	Fundamental
Peak		-
Avg.		-

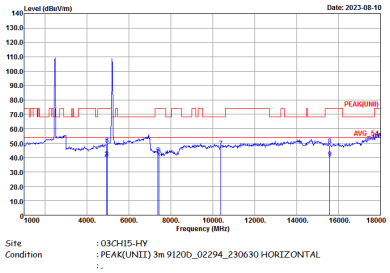
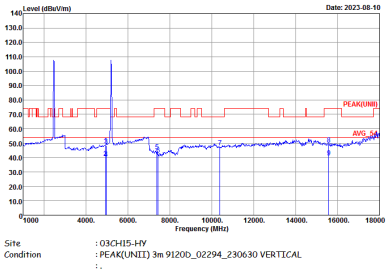
WIFI	Band 1 5150~5250MHz Band Edge @ 3m	
ANT	802.11ax HE40_Tx_CH38 5190MHz	
6+7	Vertical	Fundamental
Peak		
Avg.		

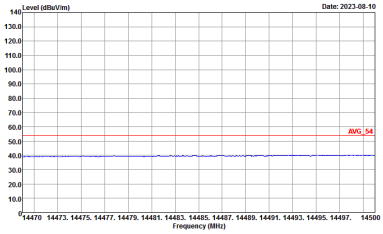
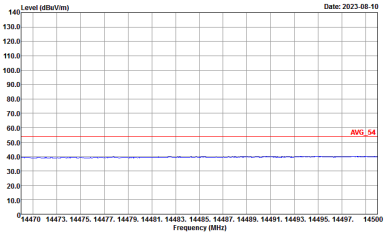
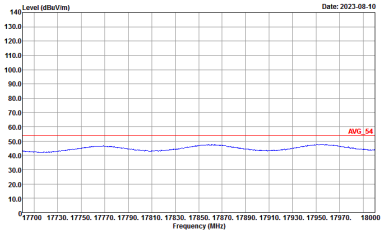
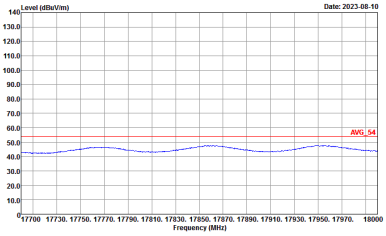
WIFI	Band 1 5150~5250MHz Band Edge @ 3m	
ANT	802.11ax HE40_Tx_CH38 5190MHz	
6+7	Vertical	Fundamental
Peak		-
Avg.		-

Bluetooth-LE + 2.4GHz 2400~2483.5MHz + Band 1 - 5150~5250MHz

Bluetooth-LE_Tx_CH39 + 802.11ax HE20_Tx_CH11 + 802.11ax HE40_Tx_CH38

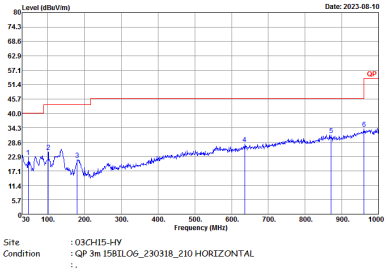
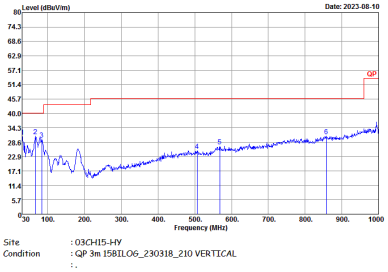
(Harmonic @ 3m)

WIFI	2.4GHz 2400~2483.5MHz + Band 1 5150~5250MHz Harmonic @ 3m	
Ant.	Bluetooth-LE_Tx_CH39 + 802.11ax HE20_Tx_CH11 + 802.11ax HE40_Tx_CH38	
Simultaneously	Horizontal	Vertical
Peak Avg.		

WIFI	2.4GHz 2400~2483.5MHz + Band 1 5150~5250MHz Harmonic @ 3m	
Ant.	Bluetooth-LE_Tx_CH39 + 802.11ax HE20_Tx_CH11 + 802.11ax HE40_Tx_CH38	
Simultaneously	Horizontal	Vertical
Avg.	 Site : 03CH15-HY Condition : AV6_54 3m 9120D_02294_230630 HORIZONTAL : .	 Site : 03CH15-HY Condition : AV6_54 3m 9120D_02294_230630 VERTICAL : .
AVG	 Site : 03CH15-HY Condition : AV6_54 3m 9120D_02294_230630 HORIZONTAL : .	 Site : 03CH15-HY Condition : AV6_54 3m 9120D_02294_230630 VERTICAL : .

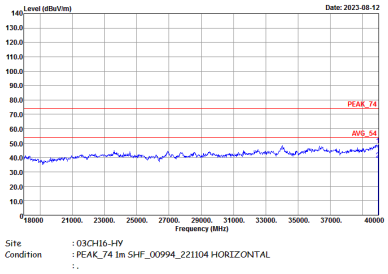
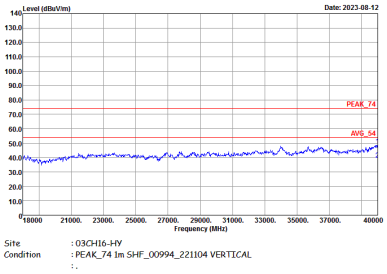
Emission below 1GHz

Bluetooth-LE_Tx_CH39 + 802.11ax HE20_Tx_CH11 + 802.11ax HE40_Tx_CH38 (LF)

WIFI	2.4GHz 2400~2483.5MHz + Band 1 5150~5250MHz LF @ 3m	
Ant.	Bluetooth-LE_Tx_CH39 + 802.11ax HE20_Tx_CH11 + 802.11ax HE40_Tx_CH38	
Simultaneously	Horizontal	Vertical
QP / Peak		

Emission above 18GHz

Bluetooth-LE_Tx_CH39 + 802.11ax HE20_Tx_CH11 + 802.11ax HE40_Tx_CH38 (SHF)

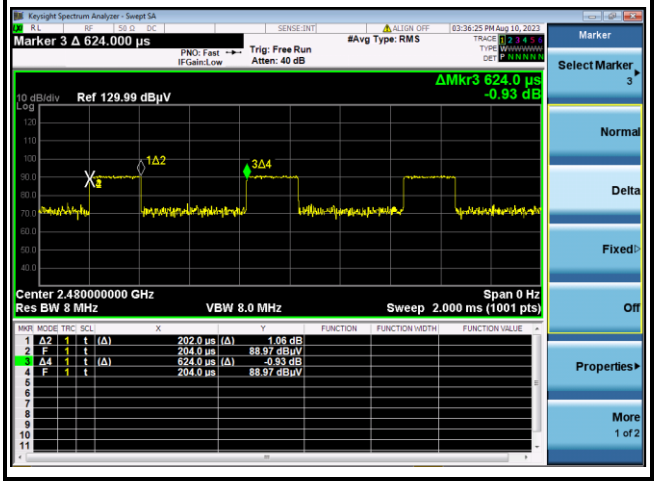
WIFI	2.4GHz 2400~2483.5MHz + Band 1 5150~5250MHz	
Ant.	Bluetooth-LE_Tx_CH39 + 802.11ax HE20_Tx_CH11 + 802.11ax HE40_Tx_CH38	
Simultaneously	Horizontal	Vertical
Peak Avg.		

Appendix C. Duty Cycle Plots

Antenna	Band	Duty Cycle(%)	T(us)	1/T(kHz)	VBW Setting
7	Bluetooth - LE for 2Mbps	32.37	202	4.95	10kHz
6	2.4GHz 802.11ax HE20 Full RU	85.76	3705	0.27	300Hz
6+7	2.4GHz 802.11ax HE20 Full RU	85.76	3705	0.27	300Hz
6+7	5GHz 802.11ax HE40 Full RU	84.09	1850	0.54	1kHz

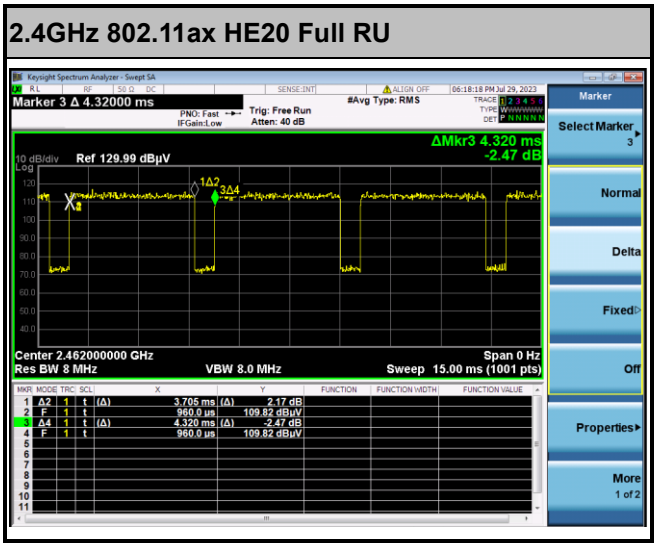
<Ant. 7>

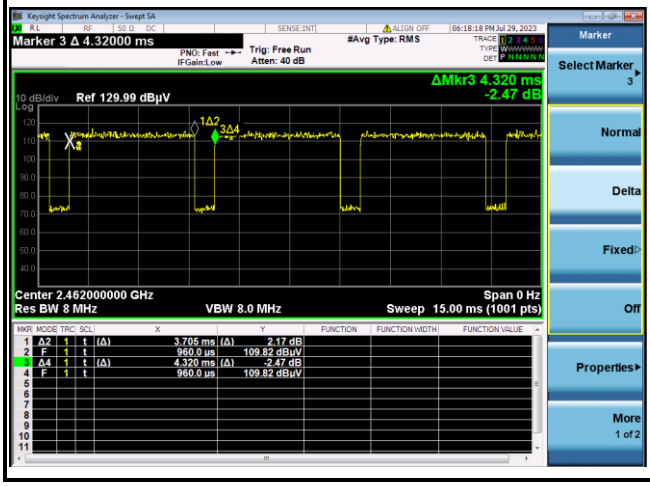
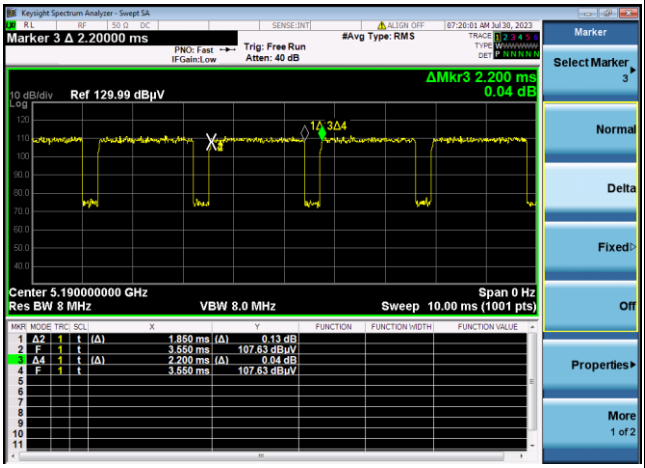
Bluetooth - LE for 2Mbps



<Ant. 6>

2.4GHz 802.11ax HE20 Full RU



MIMO <Ant. 6+7>

2.4GHz 802.11ax HE20 Full RU	5GHz 802.11ax HE40 Full RU